Base Realignment and Closure Cleanup Team Meeting Minutes
Groundwater Modeling Working Session
Former George Air Force Base, California
22 March 2006

On 22 March 2006, the George Air Force Base (GAFB) Remedial Project Managers group met at MWH's office in Sacramento, California. The following individuals attended the meeting.

Sumani Al-Hassan, Ph.D.	MWH
Indira Balkissoon	Techlaw
Milovan Beljin, Ph.D.	U.S. Environmental Protection Agency
Glenn Bruck	U.S. Environmental Protection Agency
Brenda Callen, P.G.	MWH
Jay Cass, P.E.	Regional Water Quality Control Board
James Chang	U.S. Environmental Protection Agency
Kurt Condie, P.E	MWH
Calvin Cox	Booz Allen Hamilton
Gilbert Dimidjian	MWH
William Harris, Ph.D., P.E.	Air Force Real Property Agency
Bill Mabey, Ph.D.	Techlaw
Randall Ross, Ph.D.	U.S. Environmental Protection Agency
Sandra Ross, P.G.	MWH
Susan Soloyanis, Ph.D., P.G.	Mitretek Systems

1.0 Project Schedule

The Groundwater Modeling Working Session, with the Base Realignment and Closure Cleanup Team (BCT), commenced at 9:00 a.m. at MWH's office in Sacramento, California. A sign-in sheet was circulated at the beginning of the meeting (**Attachment 1**).

The next BCT meeting and groundwater modeling working session are scheduled for 16 May 2006 and 17 May 2006, respectively. The BCT meeting will be held in the morning of 16 May 2006, followed by a field tour and site visit in the afternoon. The June BCT and groundwater modeling working session are tentatively scheduled for 14 June 2006 and 15 June 2006, respectively, at MWH's office in Sacramento, California.

The Operable Unit (OU) 1 Model Schedule was distributed to the group. Transport calibration and the majority of the sensitivity analysis were completed since the last meeting in February 2006. The draft transport data package, detailing calibration results, was submitted to the regulatory agencies the week of 13 March 2006.

The Air Force (AF) will decide before the June 2006 meeting if there is a reason to keep the OU 1 Groundwater and Extraction System (GETS) off-line. The Regional Water Quality Control Board (RWQCB) asked if the goal is to make a decision concerning reoperation of the OU 1 GETS by June 2006. The results of the modeling effort are critical to assist the AF with identification of future resource requirements. The most critical item delaying the restart of the OU 1 GETS is a determination of the appropriate discharge location of treated groundwater.

Hence, the immediate goal for the OU 1 model is to provide possible discharge alternatives for groundwater. In the long run, the AF's main goal is to use the OU 1 model to prioritize available resources and optimize the GETS for upcoming years.

2.0 Feedback on Response to Regulatory Comments - Model Development and Flow Calibration Results

The team went sequentially through each AF response to comments on the transient data package and discussed questions and concerns. The response to comments for discussion and additional questions and concerns are noted below.

Comments

Comment #15: The AF will change the comment on the source area, regarding FT-19c, indicating it was an active source through 2001.

The RWQCB asked what the attributing source of trichloroethylene (TCE) was in the southern portion of the Lower Aquifer. The AF stated that the groundwater model indicates Site FT082 is the source, with TCE entering the Lower Aquifer through the permeable lacustrine zone. The grid size in the Site FT082 source area was refined to 25 feet by 25 feet. This grid spacing was applied to an overall area of approximately 500 feet by 500 feet.

Comment #16: Total Organic Carbon (TOC) values at FT019c are higher than the rest of GAFB. This is likely a result of residual hydrocarbon contamination at the site. The AF will look at the applicability of these values in the model. The AF will also look at NZ-67 to see if that TOC value is anomalous.

The U.S. Environmental Protection Agency (USEPA) asked what the final retardation factor was for the model. The AF stated it was approximately 1.5, which will be documented in the final report.

Questions and Concerns

The AF stated that the amount of TCE mass in groundwater is currently around 2,000 pounds, approximately two times larger than the 1994 model estimate of 1,100 pounds. The AF noted that most of the extra TCE mass is from the Site FT082 area. The RWQCB asked that this be documented in a deliverable, as the 1994 model was the basis for the OU 1 Record of Decision (ROD). Documenting these differences further validates the effectiveness of the modeling effort.

The AF reviewed the revised flow results on poster board Tabs 1, 2, 3a, and 3b with the regulatory agencies. Comments and recommended changes were noted on the master sheets. The AF clarified that the poster boards are for working purposes only and will be rolled into an executive summary when the model is completed. The final modeling report will be more comprehensive and will include more result graphs showing "fits" (see definition in Section 3.0)

between actual and predicted values. Additionally, the model will identify how the groundwater system responds to major stresses.

The AF also reported that Victor Valley Wastewater Reclamation Authority (VVWRA) is expanding percolation ponds in the southern portion of their facility and the AF will account for the projected increase in flow. In addition, new sludge drying beds are being constructed in the northern portion of the facility.

3.0 Transport Calibration Results

The AF discussed transportation calibration results, as presented on Tab 4 of the poster board.

Methodology

The BCT agreed there are likely additional releases that contributed to the TCE plume, but they can not be quantified

Clarification of the transverse dispersivity was stated at one-fifth of the longitudinal dispersivity; vertical dispersivity was stated at one-hundredth of the longitudinal number.

Retardation factor is important and is used to account for uncertainties such as the organic carbon fraction. The coefficient distribution is a sensitivity parameter and will be evaluated following completion of the final selected scenario. A retardation factor of approximately 1.5 was assumed.

The TCE mass in the Upper Aquifer is not equal to the TCE mass in the Lower Aquifer and the mass moves slowly in the Upper Aquifer. The flux from the Upper Aquifer to the Lower Aquifer is slow. Dilution is occurring as soon as TCE hits the Lower Aquifer.

Source Areas

The 1996 TCE data distribution was used to set up the transport calibration. Well FT-05 was not monitored for TCE in 1996 and consistently exhibits the highest concentration in the area; as a result, a concentration of 150 micrograms per liter (μg/L) was assumed based on measured concentrations of 100 μg/L in May 1999.

The OU 3 plume was not included in the initial transport calibration. The AF will incorporate the OU 2 and OU 3 plumes into the model in the future. The model will be used to make future decisions on optimization.

The OT069 (SS083) source area was not included in the OU 1 model.

The RWQCB is concerned that there is still uncertainty concerning the division of the OU 1 and OU 3 TCE plumes. The AF's goal is to address groundwater as a whole to ensure the limited

resources are being used correctly. However, the AF acknowledged that clearer definition of the TCE plumes is needed for administrative purposes as well.

Calibration Results

The AF briefed that the flow and transport calibration periods are the same for the OU 1 groundwater model and that the transport calibration results fit better as time progresses closer to 2004.

The USEPA asked how the AF defined a good "fit" in the model. The AF explained how they compared the shape, size, and area of the contoured plumes to the predicted results from the model. The AF did not look at the high concentration areas due to needed assumptions for monitoring data that was not available from 1996. The AF noted the OU 1 model is simulating for modeling layers 1 and 2, but groundwater monitoring data is only available for the two combined layers.

The USEPA suggested comparing the TCE mass in the model versus TCE mass from recent groundwater monitoring data. This comparison may reveal an incorrect assumption or provide more lines of evidence for the accuracy of the model. The AF used a dispersion method to match the shape of the TCE plume, but this method may be inaccurate with the mass in the middle of the plume. The AF committed to completing the TCE mass estimates for the more recent data. The AF cannot prepare TCE mass estimates for the earlier dates because the groundwater monitoring network wasn't complete. In the future, the AF will track the change in TCE mass in the groundwater monitoring data against the model prediction. The RWQCB stated they would like a calculation of the volume of affected water and the aerial extent of the impacted area.

The OU 1 groundwater model will also be used as a tool to demonstrate where groundwater monitoring wells may be needed.

The USEPA asked if there will be a document produced and reviewed by the agencies prior to the simulation runs. The AF stated they are happy to share the data but are reluctant to produce a document that goes through a review cycle prior to getting to a solution. The AF needs a solution sooner, rather than later, so they can target funding requirements and return the OU 1 GETS to operation. With limited funding, the AF wants to make sure any remaining project funds are used to remediate mass and not produce a report.

The USEPA stated they don't see any fatal flaws with the OU 1 groundwater model and would like to continue the on-going process of comments and responses that is currently being used. The USEPA stated they would further consider today's material and issue additional comments to the AF.

The USEPA asked if the OU 1 groundwater model assumptions are available in writing. The AF stated assumptions are located in documents, but will be consolidated into a single list and documented on the poster boards.

The AF committed to sending an electronic data set of the transport calibration results to the USEPA to facilitate the review process.

The RWQCB asked where the off-site discharge would be placed in the scenarios. The RWQCB indicated the wetlands created by VVWRA might be the best location for off-site discharge. The AF stated that if the groundwater model recommends off-site discharge, an additional 9 to 12 months could be required for plans, permitting, access rights, and engineering. The AF is most concerned with gross results to help make this first critical decision.

The AF committed to performing quality assurance/quality control review of the data inputs for the OU 1 groundwater model to ensure the accuracy of the data being entered.

Discrepancies

Well MW-108, in the OU 1 groundwater model, is simulating TCE concentrations between 2 and 3 µg/L, but measured concentrations were between 0.5 and 12 µg/L. The USEPA indicated this is not a bad match as it is indicating some concentrations and 3 versus 12, for all practical purposes, are about the same number.

The AF located data for destroyed well NZ-45 and will add this value in to the 1996 initial plume.

The AF noted that the starting conditions for the OU 1 groundwater model scenario runs will be the actual measured concentrations present today and not the predicted results. Particle tracking will also be performed with the scenario runs.

The USEPA indicated it is important to track groundwater chemistry data, because this will show whether initial assumptions are incorrect.

The USEPA indicated concern that concentrations predicted by the model may not be seen in the groundwater monitoring network within a one year time frame. For example if the well spacing is not accurate, the concentrations that the model is predicting may not be seen.

4.0 Sensitivity Analysis Results

The AF distributed a handout with sensitivity parameter results (see **Attachment 2**). The sensitivity results represent the transient calibration over the entire time of the simulation. RMSE stands for the root mean square error.

The AF explained vertical and hydraulic conductivities are the most influential parameters effecting results. Vertical conductivity is more sensitive as its value gets larger. Hydraulic conductivity is only sensitive if its value is smaller.

The model boundary is far from OU 1 and the Adelanto fault, so general head is not sensitive to the OU 1 area.

The USEPA indicated sensitivity analysis can be masked if sensitivity is not done in its natural physical range. This would apply to all parameters, even those that are not showing sensitivity. If a parameter is already sensitive, this could further distinguish which parameters within each model layer are more sensitive. One could also apply sensitivity analysis to hydraulic conductivity in different zones. Sensitivity analysis can show different data gaps. The AF agreed and will increase the sensitivity analysis for the final scenario by up to 10 times.

Detailed sensitivity analysis will be completed for transport calibration after the final scenario is chosen. The AF indicated it would be of further value at that point. The USEPA agreed that completing sensitivity analysis after scenario runs are completed is appropriate. The AF indicated it is most cost-effective to perform modeling now.

The AF noted screen interval depths will be important as we evaluate the appropriate solution.

A list of assumptions will be issued in 2 weeks.

Response to comments will be reissued with redline/strikeout of minor changes.

Indira Balkissoon requested a hardcopy set of tabs of the model results and Jay Cass and Glenn Bruck requested pdf's of the tabs.

The AF requested comments on poster board tabs be received by 03 May 2006 so changes may be incorporated by the next meeting.

5.0 Recap and Action Items

Action items were recapped and are included as **Attachment 3**.

ATTACHMENT 1

George AFB
Groundwater Model Working Session
22 March 2006
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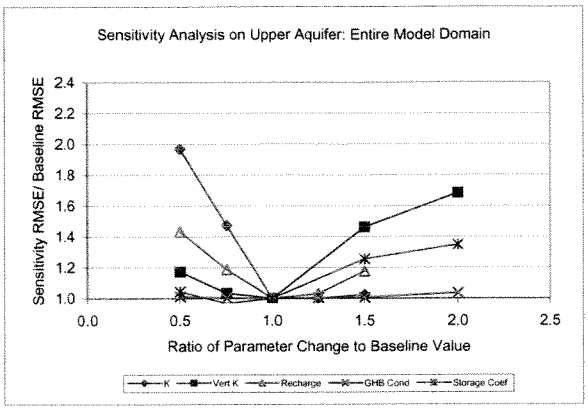
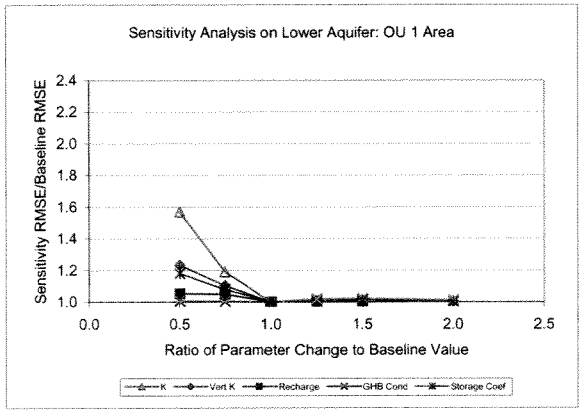
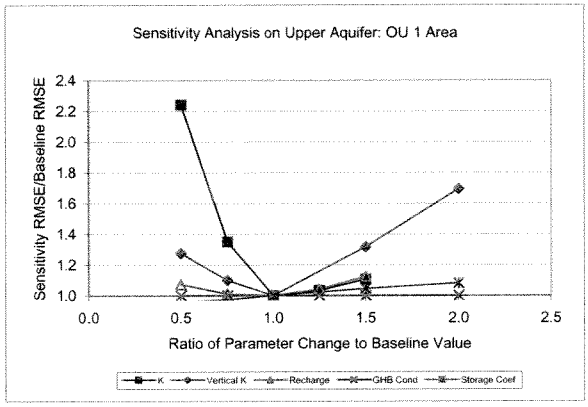
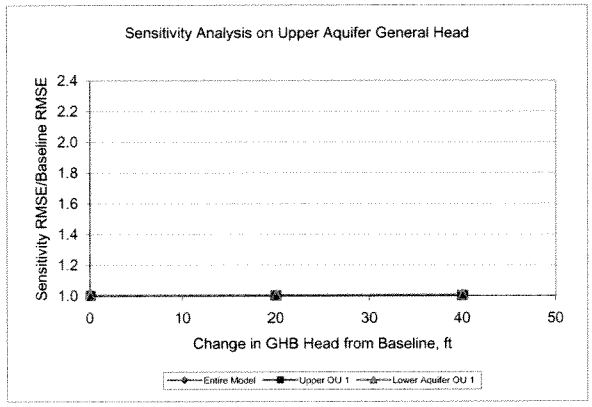
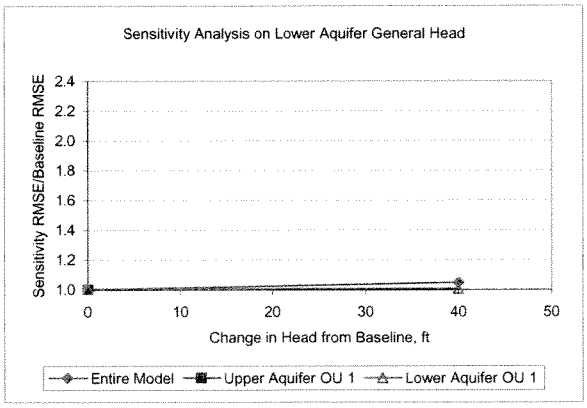
ATTACHMENT 2


Sensitivity Analysis on Upper Aquifer: Entire Model Domain
Sensitivity RMSE/ Baseline RMSE
2.4
2.2
2.0
1.8
1.6
1.4
1.2
1.0
0.0
0.5
1.0
1.5
2.0
2.5
Ratio of Parameter Change to Baseline Value
K
Vert K
Recharge
GHB Cond
Storage Coef


Sensitivity Analysis on Lower Aquifer: OU 1 Area
Sensitivity RMSE/Baseline RMSE
2.4
2.2
2.0
1.8
1.6
1.4
1.2
1.0
0.0
0.5
1.0
1.5
2.0
2.5
Ratio of Parameter Change to Baseline Value
K
Vert K
Recharge
GHB Cond
Storage Coef


Sensitivity Analysis on Upper Aquifer: OU 1 Area
Sensitivity RMSE/Baseline RMSE
2.4
2.2
2.0
1.8
1.6
1.4
1.2
1.0
0.0
0.5
1.0
1.5
2.0
2.5
Ratio of Parameter Change to Baseline Value
K
Vertical K
Recharge
GHB Cond
Storage Coef


Sensitivity Analysis on Upper Aquifer General Head
Sensitivity RMSE/Baseline RMSE
2.4
2.2
2.0
1.8
1.6
1.4
1.2
1.0
0
10
20
30
40
50
Change in GHB Head from Baseline, ft
Entire Model
Upper OU 1
Lower Aquifer OU 1


Sensitivity Analysis on Lower Aquifer General Head
Sensitivity RMSE/Baseline RMSE
2.4
2.2
2.0
1.8
1.6
1.4
1.2
1.0
0
10
20
30
40
50
Change in Head from Baseline, ft
Entire Model
Upper Aquifer OU 1
Lower Aquifer OU 1

ATTACHMENT 3

Base Realignment and Closure Cleanup Team
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Attachment 3 – Decisions and Action Items

No.	RP	Action Items	Date Started	Date Completed/ Comments
1	AF	Incorporate edits and suggestions as noted on poster boards.	3/22/06	In progress
2	AF	Particle tracking to be completed for both the Upper and Lower Aquifer.	3/22/06	
3	AF	Complete mass balance of the observed and the computed contaminant masses for the transport model.	3/22/06	Will be documented in the Final report.
4	AF	Perform a quality assurance/quality control check of the groundwater model inputs.	3/22/06	
5	AF	Prepare a list of assumptions used in the basis for the groundwater model, flow model calibration and transport model calibration.	3/22/06	In progress
6	AF	Provide transport data set of the model to Dr. Beljin.	3/22/06	
7	AF	Issue posterboards to J. Cass and G. Bruck (electronic only) and I. Balkissoon.	3/22/06	Completed, 3/24/06

Key:

AF	Air Force
BCT	Base Realignment and Closure Cleanup Team
DNAPL	Dense Non Aqueous Phase Liquid
RP	responsible party
TCE	trichloroethylene